SILVER BOW CREEK INVESTIGATION

FIELD OPERATIONS PLAN
FOR THE
SILVER BOW CREEK
FLOOD MODELLING STUDY

SILVER BOW CREEK RI/FS
EPA REGION VIII

CH2M HILL

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Prepared By:

CH2M HILL

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FIELD OPERATIONS PLAN - FLOOD MODELING STUDY LIST FOR DISTRIBUTION

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LIST OF ACRONYMS

CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980
CFR	Clark Fork River
CLP	EPA's Contract Laboratory Program
DBMS	Data Base Management System
EMSL	Environmental Monitoring Systems Laboratory
EPA	United States Environmental Protection Agency
ESD	EPA's Environmental Services Division
FIT	Field Investigation Team
FOP	Field Operations Plan
FS	Feasibility Study
DVARP	Data Validation and Reduction Protocol
ITR	Inorganic Traffic Report
LAP	Laboratory Analytical Protocol
MDHES	Montana Department of Health and Environmental Services
NBS	National Bureau of Standards
NCP	National Oil and Hazardous Substances Contingency Plan (40 CFR, Part 300)
NEIC	National Enforcement Investigations Center
NETSOP	Northern Engineering's Standard Operating Procedure
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
O&M	Operation and Maintenance
PE	Performance Evaluation
PRP	Potential Responsible Party
QAM	Quality Assurance Manager
QAO	Quality Assurance Office

QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAS	Routine Analytical Services
REM	Remedial Planning Team
RI	Remedial Investigation
ROES	Remedial Oversight Enforcement Support
RPTL	CH2M HILL's Remedial Planning Team Leader
RSPO	EPA's Remedial Site Project Officer
SAS	Special Analytical Service
SCS	Department of Agriculture, Soil Conservation Service
SMO	EPA's Sample Management Office
SMPM	State of Montana Project Manager
SOP	Standard Operating Procedure
SPM	CH2M HILL's Site Project Manager
SRM	Standard Reference Material
SSPM	Subcontractor Site Project Manager
SQAM	Subcontractor Quality Assurance Manager
USDA	United States Department of Agriculture
USGS	United States Geological Survey

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1.0 INTRODUCTION

1.1 SITE DESCRIPTION

Silver Bow Creek originates on the western slope of the Continental Divide north of the city of Butte, Montana. It drains approximately 425 square miles before forming the Clark Fork River with the confluence of Warm Springs Creek (Figure 1-1).

The history of mining in the Butte area began with the discovery of placer gold in Silver Bow Creek, in late summer of 1864. Several townsites and camps sprung up among the diggings. However, these operations were short-lived, and most of the miners left by 1869. Those who stayed began prospecting the quartz lode deposits of silver and the associated complex copper ores on the Butte Hill. Their efforts culminated in a silver rush, which began in the mid-1870's and revived the old camp. During that time world-class deposits of copper ore were identified. By 1881, Butte had become one of the nations major mining centers; the district attained national prominence by the turn of the century. By 1915, Anaconda Copper Mining Company led the industry, but in 1980, in response to a depressed copper market, Anaconda closed all the underground mines and continued active mining only in the Berkeley Pit (established in 1955). In 1977, Anaconda became a subsidiary of Atlantic Richfield Company (ARCO). ARCO closed the Berkeley Pit in 1982 and the East Berkeley pit in 1983.

The history of over 100 years of continuous mining and related activities changed the area's natural environment greatly. Early mining, milling, and smelting wastes were dumped directly into Silver Bow Creek and transported downstream to the Clark Fork River. In 1911, the first treatment pond was built by Anaconda Company near Warm Springs, Montana, to settle out wastes from Silver Bow Creek before the water was allowed to move on. In 1916 and 1959, two more treatment ponds began operation. Silver Bow Creek continued to receive raw mining and milling wastes until 1972, when a treatment plant was added to the Weed Concentrator in Butte. Creek contamination problems were compounded by urban and domestic sewage, wood products treatment

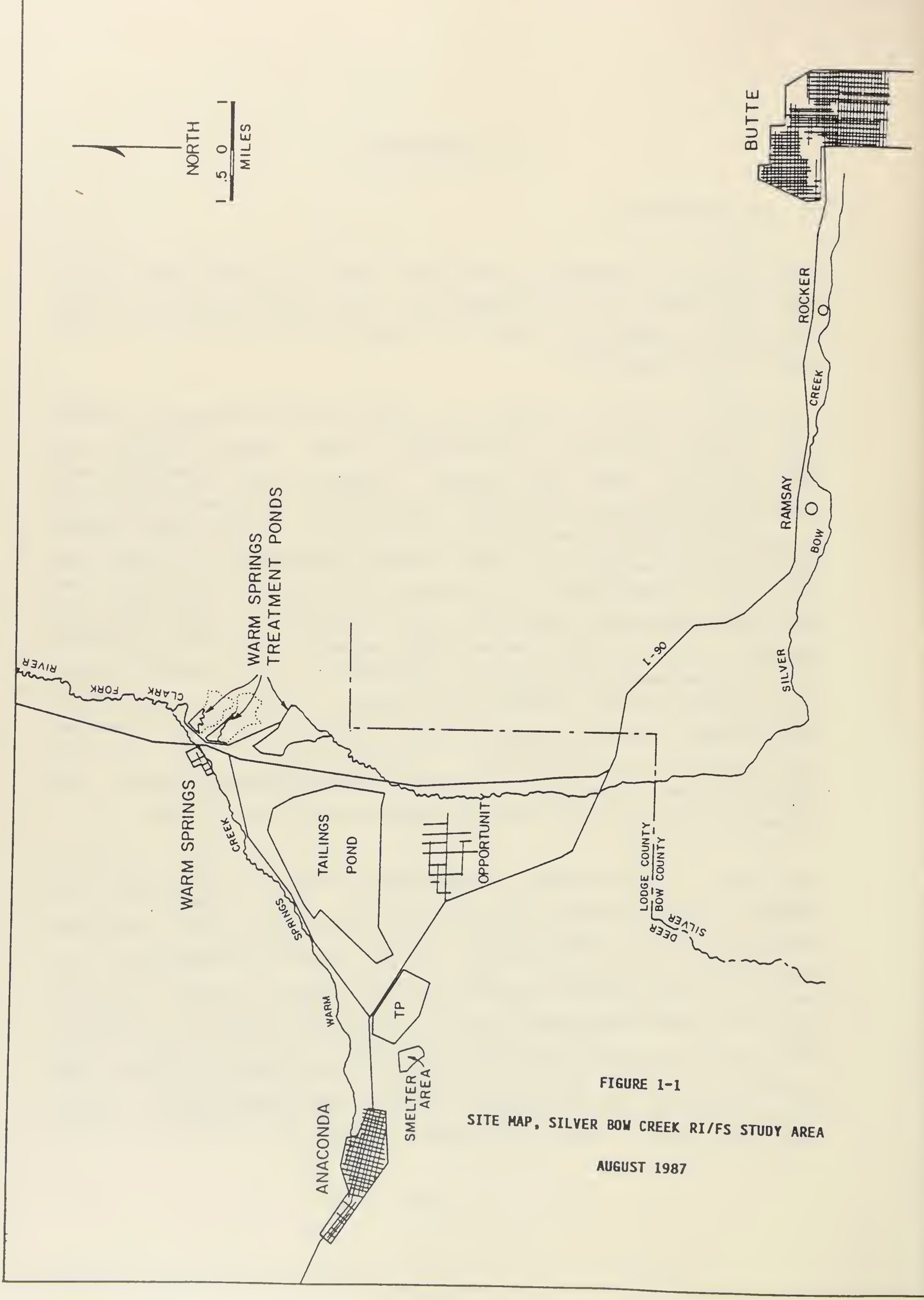


FIGURE 1-1

SITE MAP, SILVER BOW CREEK RI/FS STUDY AREA

AUGUST 1987

plants, phosphate and manganese production facilities, and chemical factories. Mill tailings and other mining wastes in and near the creek contribute to substantial downstream contamination, particularly by potentially toxic elements: arsenic, cadmium, copper, lead, iron, and zinc. These elements and others were present in the mine ore and remain as by-products of the milling and smeltering processes.

1.2 PROJECT HISTORY

In 1983, the U.S. Environmental Protection Agency (USEPA) designated Silver Bow Creek, contiguous portions of the upper Clark Fork River, and their environments as a high priority Superfund cleanup site. The Solid and Hazardous Waste Bureau (SHWB) of the Montana Department of Health and Environmental Sciences (MDHES) administered the USEPA appropriations to conduct a Remedial Investigation (RI) of the Silver Bow Creek (SBC) drainage. The Silver Bow Remedial Investigation (SBC RI) project was contracted in 1984 to MultiTech and they were assisted in the SBC RI work by Stiller and Associates of Helena and various other subcontractors. Several state and federal agencies also provided technical information and expertise, including the USEPA bioassay team, the Montana Department of Fish, Wildlife and Parks, the Montana Water Quality Bureau, and the USEPA Montana Field Office.

The SBC RI consisted of coordinated individual studies to develop data on the extent and severity of contamination within the site. Final field work by MultiTech et. al. was completed in January 1986 with results of the studies being reported by MultiTech in 1986-1987 in several volumes. A Summary Final Report discusses the entire project; final reports for each individual study have been issued as appendices to the Summary, as shown below:

* Surface Water and Point Source Investigation, Appendix A, Parts 1-3;
* Ground water and Tailings Investigation, Appendix B, Parts 1-3;
* Warm Springs Ponds Investigation, Appendix C;
* Algae Investigation, Appendix D, Part 1;
* Vegetation Mapping, Appendix D, Part 2;

* Agriculture Investigation, Appendix D, Part 3;
* Macroinvertebrate Investigation, Appendix E, Part 1;
* Bioassay Investigation, Appendix E, Part 2;
* Fish Tissue Investigation, Appendix E, Part 3;
* Waterfowl Investigation, Appendix E, Part 4; and
* Laboratory Quality Assurance/Quality Control Program, Appendix F.

CH2M Hill was selected in early 1986 to continue these RI efforts and to begin FS activities were possible. In November, 1986, CH2M Hill presented a draft Remedial Investigation/Feasibility Study Work Plan for the Silver Bow Creek CERCLA site. The work plan indicated that a large number of data gaps had been identified that might need to be filled before the feasibility studies on this site could be successfully completed. The plan outlined a strategy for determining which of these data gaps would ultimately have to be studied. While preparing the plan several data gaps were identified that are somewhat independent of the applicable or relevant and appropriate State and Federal requirements (ARAR's) that might be selected. That is they will have to be studied despite the clean up goals that are ultimately chosen for the site. The areas were identified as follows:

- o Characterization of the former Rocker Timber Treatment Plant

- o Additional ground water study near the former Butte Reduction Works (Area I)

- o Additional study of the Warm Springs Treatment Ponds

- o A flood study on Silver Bow Creek

A meeting was held on April 9, 1987 with representatives from MDHES, the Environmental Protection Agency (EPA), and various scientific disciplines to discuss the four specific areas of study on the Silver Bow Creek CERCLA project. The purpose of the meeting was to gain initial agreement on the scope of work for these study areas and to discuss how these objectives

might be met. The results of subsequent meetings was the preparation of this Field Operating Plan (FOP) which addresses the Flood Study for Silver Bow Creek. Separate FOPs were also developed which address the three other selected data gap study needs.

1.3 SCOPE OF WORK

During the RI work completed from 1985 through 1987, there have been drought conditions in the Silver Bow Creek watershed. This has resulted in extremely low runoff with no high flow events being sampled or recorded during this time. It is known, however, that during the higher flow events increased contamination within Silver Bow Creek occurs as a result of contact with metal laden sediments that exist in the flood plain areas.

For the highest flow event sampled during the RI, most measured total metals exceeded Federal drinking water standards at most of the sampling points. This demonstrates that the severity and extent of suspected contamination increases during high flow events. This one high flow event will be used where possible to verify computer model construction which is addressed in this FOP.

It is necessary to understand the hydrologic and hydraulic characteristics of Silver Bow Creek at various flood stages in order to adequately evaluate potential remedial alternatives of the site. This requires knowledge of peak flow values during specific flood frequencies and the associated flooded areas and sediment transport capabilities for these events.

Since the RI data were unable to provide information during high flow events, the objective of Silver Bow Creek flood modeling is to provide synthetic flow quantities for the 10- 25- and 100-year flood events using computer simulation of flow characteristics in the watershed (hydrologic modeling). This will provide data necessary to analyze impacts to the SBC drainage system during high flow events. Calculated flood hydrographs will provide flood hydrograph volumes and instantaneous peak discharges for

the selected recurrence interval (frequency) and will assist in the evaluation of the effect of high flows and storm runoff on floodplain tailings deposits and present or future impoundments.

Calculated flood peaks from a hydrologic model will also be used as an input variable to a hydraulic model of SBC. The hydraulic model will provide estimates of water surface elevations during the specific high flow events. With these elevations, overbank flooded areas will be determined, and an estimate of flow velocities will be obtained. Velocities in both overbank and channel areas are needed to address sediment transport potential.

To provide these high flow estimates the following computer programs that will be used are presented with a brief description of their input parameters requirements.

HEC-1: This program will be used for the hydrologic data needs. The program will compute synthetic hydrographs at specific locations within the basin being studied. HEC-1 is designed to simulate the surface and stream channel response of a river basin to precipitation (rainfall, snowmelt, etc.). Both flood volume and instantaneous peak discharge will be computed by this program for the 10- 25- and 100-year floods. Basic data requirements for the model construction are physical properties of the basin including length of watercourse, slope, vegetation within the watershed, infiltration capability, size of stream channels, precipitation values; snowmelt and/or rainfall quantities; temperature variations; and possible diversion data.

HEC-2: This program will be used to estimate water surface elevations and velocities during the instantaneous peak discharges for the 10- 25- and 100-year floods calculated by the HEC-1 computer program. The HEC-2 computer program was developed using the computational procedure generally known as the Standard Step Method for calculating water surface profiles for steady gradually varied flow in natural stream channels. It will provide backwater elevations in channels caused by friction and effects of various obstructions such as bridges, culverts, weirs

and hydraulic structures in the main channel and flood plain areas. Basic data needed to perform the backwater computations include flow regime (subcritical or supercritical flow) peak discharges (obtained by HEC-1), loss coefficients (friction, expansion and contraction), cross section geometry (main channel, flood plain and hydraulic structures) and reach lengths between surveyed cross sections (channel and overbank flood plain flow distances).

HEC-6: This computer program will be used to estimate sediment transport during the 10- 25- and 100-year flood events. Commonly known as Scour and Deposition in Rivers and Reservoirs, this program can analyze reservoir deposition to determine both the volume and location of sediment deposits. Degradation or agradation of the streambed or long term trends of scour or deposition in a stream channel can be simulated. By entering a sequence of water discharges from a discharge hydrograph (obtained from HEC-1), changes are calculated with respect to time and with respect to distance along the model for each of the following: total sediment load; volume and gradation of sediment that is deposited; armoring of the bed surface; resultant bed elevation and sediment outflow at the downstream end of the stream reach. Input data needs for the program include channel and overbank floodplain geometry (obtained for the HEC-2 analyses) discharge hydrograph, sediments load and gradation of material in the flooded areas.

The field tasks associated with the flood modelling effort are field reconnaissance, field surveys and sediment sampling and are described as follows:

1. Field Reconnaissance:

Field reconnaissance of the study area will be made to determine conditions along the flood plains, types and number of hydraulic structures involved, locations of cross sections to be surveyed;

to provide photo documentation of field conditions; and to select locations where sediment samples will be taken which are needed for the sediment transport analyses.

Criteria for setting cross section locations include determining intervals along a stream to characterize the flow carrying capability of the stream an its adjacent flood plains. Sections should extend across the entire flood plain and should be perpendicular to the anticipated flow lines (approximately perpendicular to contour lines). Cross sections are required at representative locations throughout a stream reach and at locations where changes occur in discharge, slope, shape, roughness, variation in sediment characteristics and at bridges or control structures such as weirs or dams. Where abrupt changes occur, several cross sections should be used to describe the change regardless of the distance. Cross section spacing is also a function of stream size, slope, and the uniformity of cross section shape. It is anticipated to space cross sections at approximately 750 ft. intervals along the natural channel areas. At structures up to three additional cross sections; one at the upstream and/or downstream face of the structure, plus a cross section to provide roadway profile geometry, will be used to characterize the flow through the structure and any backwater caused by the structure. This will results in approximately a total of 275 to 300 sections for the study reach.

2. Field Surveys and Aerial Photography and Digitizing:

Field surveys of Silver Bow Creek will be conducted to obtain channel and flood plain cross sections, identify or establish necessary Elevation Reference Marks (ERMs), and obtain the physical dimensions of all hydraulic structures. Third-order leveling shall be used to tie temporary bench marks and ERMs to the National Geodetic Vertical Datum of 1929 (NGVD); to determine the elevation of known high-water marks; and, where needed, to establish vertical and horizontal control for aerial photogrammetry and digitizing.

Standard photogrammetric methods will provide the information needed to prepare the required models including cross sectional data and possible future topographic contours of the flood plain. Other secondary benefits of aerial survey techniques include the updating of base map features, estimation of Manning's roughness coefficients, identification of hydraulic control structures, and selection of cross section locations.

The photography must be flown while the sun angle is above 30 degrees and the watercourses are in the main channels, and it must be suitable for use in a stereoplotting instrument. Accuracy requirements for determining spot elevations of ground points are that ninety percent of all spot elevations placed on the maps have an accuracy of at least one-foot and the remaining 10 percent not be in error by more than two feet.

Coordinate Grid Lines (if used). The plotted positions of each plan coordinate grid line shall not vary by more than 0.01 inch from true grid on each map.

Horizontal Control. Each horizontal control point shall be plotted on the map, with the coordinate grid in which it should lie, to an accuracy of 0.01 inch of its true position as expressed by the plane coordinates computed for the point. Should non-coordinate control procedures be utilized, the same accuracy shall pertain to the plotting of any type of control points.

Planimetric Features. Needed planimetric features that are well defined on the photographs shall be plotted so that their position on the maps will be accurate to within at least 0.025 inch of their true coordinate position. None of the features shall be misplaced on the maps by more than 0.05 inch from their

true coordinate position. When map production is accomplished without the benefit of a grid coordinate system, then the accuracy shall be interpreted as the distance between any two well-defined points.

Vertical Control. The field surveys will be performed to maintain vertical photogrammetric control, with all elevations referred to NGVD. Vertical control points for stereomodels may be established by other than third-order procedures if elevations are accurate to within ±0.4 foot and are determined from bench marks of third-order accuracy.

Analytical Control. The maximum number of stereomodels acceptable in photogrammetric bridging is 4 for vertical control and 10 for horizontal control. Strip adjustment is acceptable for single flight lines, but simultaneous bundle adjustment shall be used on two or more parallel flight lines. The root Mean Square Error for aerial analytical triangulation is 1:8000 absolute error as a fraction or flight height with horizontal and vertical points.

3. Sediment Sampling:

This effort will involve collecting 36 grab sediment samples from 12 sites on Silver Bow Creek and selected tributaries. For each of the 12 sites selected during the field reconnaissance effort one sediment sample will be obtained of each main channel, left overbank and right overbank areas. Criteria for locating sediment sample sites include selection of areas where the sediment is representative of the river reach of concern. Changes in sediment distribution and size is a function of sediment supply, slope of river channel, and flow areas of scour and deposition. These areas will be located along the river reaches with sediment samples taken at these sites. For estimating purposes it is assumed the 12 sites will be sufficient to accurately catagorize and classify the sediments within Silver Bow Creek Watershed.

The samples will be analyzed for hydraulic properties which are size gradation, shape, unit weight and classification of sediment (clay, silt, sand and larger). For sediments greater than 3 1/2 inches in diameter field estimates will be made to determine the percentage of total sediments for this size. A 25 ft. by 25 ft. transparent grid will be laid out in 5.0 ft. by 5.0 ft. squares and the number of particles within the size ranges of 3 1/2 to 6.0, 6.0 to 12, 12 to 24 and greater than 24 inches will be determined in order to estimate the percentage of total sediment load comprised of these size particles. Estimated depths of sediments will be made for the channel and floodplain area by use of digging through the material with shovels. Where depth are greater than 3.0 feet estimates will be made by using an auger to a maximum depth of 6.0 ft. Photo documentation will be made of all grab sample locations. These data will be used as input parameters for construction of the sediment transport model (HEC-6) during potential flooding events.

2.0 QUALITY ASSURANCE/QUALITY CONTROL

The objective of field reconnaissance, field surveying, and sediment sampling to be completed in conjunction with this investigation is to obtain data of known quality for input in development of the hydrologic, hydraulic and sediment transport models. To meet this objective, a Quality Assurance Project Plan (QAPP, CH2M HILL, 1987b) has been developed; Quality Assurance considerations specific to this FOP are described in Table 2-1. Table 2-2 shows the Quality Control limits and Corrective Actions for Field and Laboratory QC Samples.

The Silver Bow Creek RI/FS study area is a Superfund enforcement site. In an enforcement study, all information and data gathered during the project must be defensible in a court of law. The following requirements must be met to obtain defensible data.

- Strict chain-of-custody must be maintained for all sediment samples collected, from time of collection to the time of completion of all analyses. Section 4.0 "Documentation and Field Observations" contains further information on this subject.

- All data must be of known quality. Sample duplicates will address the quality of sediment data collected. To meet data quality objectives, several QA/QC parameters will be addressed including comparability, completeness, representativeness, accuracy, and precision. Further discussion of QA/QC parameters is contained in the project QAPP (CH2M HILL, 1987b).

- All field survey data will be collected using criteria as set forth by the Federal Emergency Management Agency for development of field surveys and photo control used in flood insurance studies.

TABLE 2-1

QA/QC CONSIDERATIONS FOR

SILVER BOW CREEK FLOOD MODELLING STUDY

1. The Document Control Officer (DCO) will be properly trained in document control and personally responsible for all document custody.

2. The collection of specific descriptive or semi-quantitative data will always be performed by the same person(s) as specified in the appropriate Standard Operating Procedure (SOP).

3. Standard operating procedures for all field tasks will be followed (see Appendix A). Any deviations from SOPs which may be required by field conditions must be approved by the Team Leader and noted in the logbook. Any changes will be relayed to the CH2M HILL Site Project Manager (SPM) for approval.

4. Any serialized documents that are inadvertently destroyed must be recorded in the logbook as destroyed.

5. Any sampling equipment used for more than one sampling unit will be decontaminated between samples by the appropriate SOP to prevent cross contamination.

6. QA/QC samples will be inserted blind into the sample train for sediment sampling at a minimum of one QA/QC for each six natural samples.

7. Field survey checks will be conducted on one hydraulic structure in five for one center line control point.

8. One photo control point in 10 will be field checked by a separate survey quality control crew.

9. One digitized cross section in 25 will be field checked by the separate survey quality control crew.

TABLE 2-2

QC LIMITS AND CORRECTIVE ACTIONS FOR FIELD AND LABORATORY QC SAMPLES

Field Survey Check	Hydraulic structure, vertical control point check will agree with 0.10 ft vertically	1. Resurvey and recheck
Field Survey Check	Digitized cross section will agree within 1.0 ft with field cross section survey check	1. Redigitize 2. If still outside 1.0 ft recheck photo control surveys
Replicate	Replicate samples shall have a RPD less than 20%	1. Reanalyze samples 2. If still outside 20% all associated data is unvalidated 3. Resample and reanalyze

3.0 SAMPLING AND MEASUREMENT

3.1 OVERVIEW

Data collected during the investigation described here will be used in the Silver Bow Creek Feasibility Study. In general, objectives of this work plan are to collect field data that will aid in the development of computer models for hydrologic conditions, hydraulic conditions and sediment transport potential of Silver Bow Creek from its headwaters to Warm Springs Ponds (Figure 1). These models will provide data needed on high flow parameters not available at this present time.

There are three major components of this FOP:

1. field reconnaissance,
2. field surveys, and
3. sediment analyses.

Table 3-1 contains a summary of sediment samples for analytical testing, exclusive of duplicate samples. A discussion of QA/QC sampling is contained elsewhere in this plan.

Necessary sampling, measurement, and safety equipment have been identified (Table 3-2). Locations of sampling sites will be selected following field reconnaissance.

3.2 FIELD RECONNAISSANCE

3.2.1 Purpose of Effort

This effort is to visually inspect all hydraulic structures; visit the entire area to familiarize oneself of the main stream and overbank floodplain condition; to lay out areas where cross sections will be taken, to obtain roughness coefficients of the flood plain and main channel areas, to identify locations where sediment samples will be taken and obtain other parameters needed for hydrologic, hydraulic and sediment transport modeling analyses.

TABLE 3-1
SUMMARY OF SAMPLE TYPES AND QUANTITIES

Type of Sample	Quantity[a]	Parameters
Bedload and flood plain sediment sampling	12 sites 36 samples	sieve analysis, air-dry weight of bedload sediment

[a] Excludes duplicate samples.

TABLE 3-2

SEDIMENT SAMPLING, AND

SAFETY EQUIPMENT FOR FLOOD MODELLING

FIELD DATA COLLECTION

Deionized Water (10 Gallons)	Calculators (2)
Squeeze Bottle (2)	Paper Towels (10 Rolls)
100' Tape	Garbage Bags
Hip Boots (2 pairs)	Wash Basins (2)
5-Gallon Buckets (2)	Brushes (2)
Stakes and Hammer	Liquinox (1 Gallon)
Surgical Gloves (100 Pairs)	Analysis Request Forms
Rubber Gloves (6 Pairs)	Tool Kits (1)
Shoulder Length Rubber Gloves (2 Pair)	First-aid Kits (1)
Site Checklist	Fire Extinguishers (1)
Indelible Ink Pens (2)	Heavy Duty Zip-Lock Bags (40)
Shovels (2)	Strapping Tape (2 Rolls)
Chain-of-Custody Forms	Blankets (1)
Sample Custody Seals	EPA Sample Tags (20)
Ice Chests (36)	Sample ID Matrix Forms
Wheelbarrow	SAS Packing List
Field Notebooks	Clear Tape; 2-inch wide (2 Rolls)
	Garden Sprayer (3 gallon)

3.3 FIELD SURVEYS

3.3.1 Purpose of Effort

This effort is to set known elevations control for all hydraulic structures and horizontal and vertical photo control for future digitizing of cross sections and hydraulic modelling.

During the field reconnaissance effort surveys needed for all hydraulic structures will be identified and relayed to the survey crew. Exact requirements will be set forth at that time due to site specific survey requirements. However elevations for top of roadway, low and high chord elevations, water surface elevations at the upstream and downstream face as well as approximately 75 to 100 ft upstream and downstream of the structure, invert elevations both upstream and downstream of the structure, physical geometry of the waterway opening through the structures as well as the geometry of the structures itself will be obtained.

After the Silver Bow Creek main channel and flood plain area have been flown, exact locations of needed horizontal and vertical control points will be identified on the aerial photography. These control points will then be field surveyed so as to be able to use the photography for digitizing of needed channel and overbank flood plain cross sections.

At this time there is estimated 70 photographs needed to cover the entire stream reach, with approximately 120 field surveyed points needed to meet horizontal and vertical control requirements for digitizing and mapping.

3.4 SEDIMENT SAMPLING

3.4.1 Purpose of Sampling

At the present time, the quantity of sediment rolling and/or saltating along the Silver Bow Creek streambed and floodplain is unknown. Because of this it is necessary to construct a model that will provide an estimate of the quantity of sediment that potentially will be moved during

high flow events. Sampling of bedload and overbank sediment is therefore necessary to provide size gradation and makeup of the sediment contained in the Silver Bow Creek flood plain and main channel areas.

3.4.2 Sample Locations

Due to site specific sediment sampling requirements, exact sites of the estimated 12 sample locations will be selected following the field reconnaissance effort.

3.4.3 Sample Quantities

Approximately 36 samples will be obtained at 12 sites on Silver Bow Creek and its tributaries. Parameters to be analyzed from the sediment samples collected are particle size and distribution and air-dry weight.

3.4.4 Procedure

Sediment samples will be collected in accordance with SOP001.

4.0 DOCUMENTATION AND FIELD OBSERVATIONS

4.1 LABELING

All samples will be labeled in the field using CH2M HILL's numbering and coding system. The samples will then be tagged with EPA sample tags and sealed with custody tape (Figure 4-1) and logged on chain-of-custody forms (Figure 4-2). Special Analytical Services (SAS) forms (Figure 4-3), and Sample ID matrix (SIM) forms (Figure 4-4) will b e maintained (CH2M HILL SOP002, Appendix A).

4.1.1 Initial Labeling

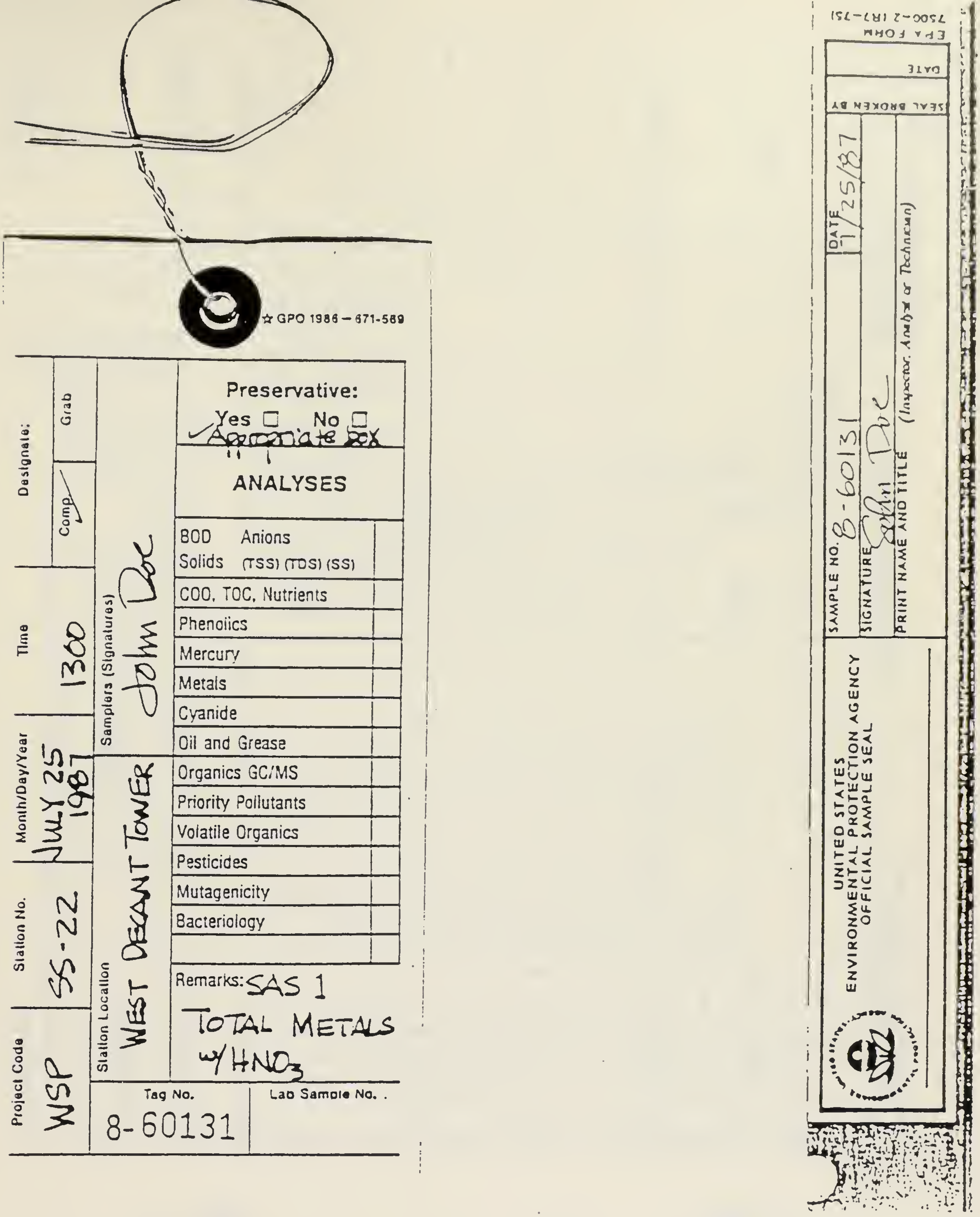
All sample containers will be labeled with an indelible pen prior to being filled at the sampling site. The sample label will show the date, time of sampling (military time), sampler's initials, sample site number, EPA Tag number and type of analysis.

4.1.2 Sample Numbering System

A sample numbering system will be used to identify each sample site. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. A listing of sample identification numbers with written descriptions of sample location, type, dates sampled, etc., will be maintained. Each sample number will be composed of the following components:

Project Identifier -- A four letter designation will be used to identify the site where the sample is collected. For this project, it will be SBCS which stands for Silver Bow Creek Sediment.

Sample Type -- Each sample type collected during the sampling program will be identified by a 3-letter alpha code: This will be SED - Sediment Sample.



☆ GPO 1986 — 671-589

Project Code: WSP
Station No.: SS-22
Month/Day/Year: JULY 25 1987
Time: 1300
Designate: Comp. ✓ Grab
Station Location: WEST DECANT TOWER
Samplers (Signatures): John Doe
Preservative: Yes ☐ No ☐
✓ Appropriate box

ANALYSES

BOD Anions	
Solids (TSS) (TDS) (SS)	
COD, TOC, Nutrients	
Phenolics	
Mercury	
Metals	
Cyanide	
Oil and Grease	
Organics GC/MS	
Priority Pollutants	
Volatile Organics	
Pesticides	
Mutagenicity	
Bacteriology	

Remarks: SAS 1 TOTAL METALS w/ HNO_3

Tag No.: 8-60131
Lab Sample No.:

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
OFFICIAL SAMPLE SEAL

SAMPLE NO. 8-60131
DATE 7/25/87
SIGNATURE John Doe
PRINT NAME AND TITLE (Inspector, Analyst or Technician)

SEAL BROKEN BY
DATE

EPA FORM
7500-2 (R7-75)

FIGURE 4-1

EPA SAMPLE TAG AND CUSTODY TAPE
FOP
SILVER BOW CREEK FLOOD MODELLING STUDY
AUGUST 1987

U.S. ENVIRONMENTAL PROTECTION AGENCY
Environmental Services Division

CHAIN OF CUSTODY RECORD

REGION VIII, ONE DENVER PLACE
999 18TH. STREET
DENVER, CO 80202-2413

PROJ. NO.	PROJECT NAME
	WSP

SAMPLERS: (Signature) John Doe

STAT. NO	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS	1 LITER POLY/RAW	1 LITER POLY FILTER w/HNO3	1 LITER POLY w/HNO3				REMARKS
SS-22	July 25 1987	1300	✓		W. DECANT TOWER	4	1	1	2				EPA TAG # 8-60131 thru 8-60134

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	

Split Samples: ☐ Accepted ☐ Declined Signature

Distribution: Original Accompanies Shipment; First Copy to Coordinator Field Files; Second Copy to Representative of Inspected Facility

R8 EPA-014B (4 21 88)

8-31675

FIGURE 4-2

CHAIN-OF-CUSTODY FORM
FOP
SILVER BOW CREEK FLOOD MODELLING STUDY
AUGUST 1987

SPECIAL ANALYTICAL SERVICE

PACKING LIST

Sampling Office: NET	Sampling Date(s): JULY 25 1987	Ship To:	For Lab Use Only
Sampling Contact: JOHN DOE (name)	Date Shipped:		Date Samples Rec'd:
800-622-7960 (phone)	Site Name/Code: WSP	Attn:	Received By:

	Sample Numbers	Sample Description i.e., Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1.	8-60131	SAS 1 - H_2O - LOW	
2.	8-60132	SAS-4 - H_2O - MEDIUM	
3.	8-60133	SAS-5 - H_2O - LOW	
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.	8-60150	SAS-5 - H_2O - LOW	

White - Sample office Yellow - Lab Copy Pink - Return to sample office upon receipt

FIGURE 4-3

SPECIAL ANALYTICAL SERVICE FORM

FOP

SILVER BOW CREEK FLOOD MODELLING STUDY

AUGUST 1987

CH2M HILL
SAMPLE IDENTIFICATION MATRIX

BY: JOHN DOE   DATE: JULY 25 1987   PROJECT NO: ____

SITE: WSP

ACTIVITY: SURFACE WATER

CASE/SAS NUMBER: ____

INSTRUCTIONS

- ONE SI MATRIX PER COOLER/COC
- SEND SI MATRIX WITH SAMPLE CODE OBSCURED TO LAB
- SEND SI MATRIX TO SMO
- ANALYSIS CODES COMPLETED BY SAMPLERS IN ACCORDANCE WITH CLP REQUEST
- ONE CONTAINER AND TAG NUMBER PER LINE

NOTES: ____

STATION LOCATION	SAMPLE TYPE	SAMPLE CODE	ANALYSIS CODE	SMO NUMBER	SAMPLE TAG NUMBER	BOTTLE SIZE & TYPE	QC BOTTLE LOT NUMBER	DATE/TIME SAMPLED	PRESERVATION CODE	COMMENTS
W DECANT TOWER SS-22	SW-11-C	N	SAS 1		8-60131	1 IPB	CECP 3092	JULY 25, 1987	RPZ	
"	SW-11-C	N	SAS 4		8-60132	"	"	@ 1300	RPZ	
"	SW-F-C	N	SAS 5		8-60133	"	"	"	RPZ	
"	SW-11-C	N	SAS 6		8-60134	"	"	"	RMP	

CLP LABORATORY ____ PHONE ____

CHAIN OF CUSTODY NUMBER ____

DATE SHIPPED/CARRIER ____

AIRBILL NUMBER ____

ANALYSIS CODES:
SAS 1 - TOTAL METALS
SAS 4 - ACID SOLUBLE
SAS 5 - DISS METALS
SAS 6 - COMMONS

FIGURE 4-4

SAMPLE IDENTIFICATION MATRIX FORM
FOP
SILVER BOW CREEK FLOOD MODELLING STUDY
AUGUST 1987

Station Number -- The third component of the sample number will be a 2-digit station number. The serial number will be used to identify locations from descriptions written in the field log book.

Examples of the numbering system to be used for natural and QC samples are:

Natural Sample SBCS-SED-10

Where:

SBCS - Silver Bow Creek Sediment
SED - Sediment
10 - Station number

4.2 SAMPLE CONTROL

EPA serialized sample tags will be used to label each sample for analysis. Chain-of-custody records will be completed for all samples according to EPA requirements and will accompany sample shipment. Correctly completed custody seals will be placed on all sample containers and ice chests containing samples.

4.3 FIELD NOTEBOOKS

Field forms will be used for recording the data-collecting activities performed at a site (see CH2M HILL SOP-03, Appendix A). The forms will be numbered consecutively. Field forms will be assigned by the DCO to field crew leaders and/or to the person in charge of sampling. Field forms will remain in that person's custody during the sampling activity.

Entries on field forms will include sufficient detail to reconstruct site activities without reliance on memory. At the beginning of each entry, the date, start time, weather, field personnel present, level of personal protection, and the name of the person making the entry will be

recorded. The names of visitors and the purpose of their visit also will be recorded in the site team leader's field form. Any deviation from SOPs will also be noted.

All samples collected will be recorded. All entries will be in ink, weather permitting with no erasures. If an incorrect entry is made, the information will be crosses out with a single strike mark and initialed and dated. Whenever a sample is collected or a measurement made, a detailed description of the station location, sample identification, and type of sample will be recorded. The film roll number and number of photographs taken of the station will also be noted, where applicable. All equipment used to make measurements will be identified, including the most recent calibration date.

Samples will be collected following the SOPs documented in this plan. The equipment used to collect samples will be noted, along with the sampling time, sample description, and number of containers. In addition, the number of the ice chest into which the sample is placed in the field will be recorded. Sample numbers will be assigned prior to going onsite.

5.0 PROJECT PERSONNEL

Field personnel and associated responsibilities proposed for the project include the following:

Field Crew Supervisor: J. Gerick
Field Crew Leader: S. Mitchell, J. Franklin
Document Control Officer: S. Staley
Safety Officers: J. Franklin, S. Mitchell
Assistant Safety Officers: S. Staley, D. Hazen

Functions of the individuals or entities presented above are as follows:

Field Crew Supervisor -- responsible for all phases of field data collection including equipment and materials procurement, sampling logistics, packaging and custody, and data compilation and presentation.

Field Crew Leader -- responsible for field data collection at the crew level. Includes supervision of assigned crews to collect viable, defensible data in accordance with the project FOP and QAPP.

Document Control Officer -- responsibilities are to: (1) ensure data and documents are released and distributed in accordance with EPA requirements, (2) ensure data and documents are kept secure, under custody when necessary, without unauthorized reproduction and/or alteration, and (3) ensure document or data holders are known.

Safety Officer(s) -- responsibilities include those associated with implementing and enforcing the project safety plan. Includes conducting briefings for field crews as necessary, providing appropriate and adequate safety equipment for all field crews, and supervising adherence to the plan.

6.0 SAMPLE CONTAINERS, PRESERVATION, AND SHIPPING

6.1 SAMPLE CONTAINERS

All sample containers used during this FOP will be 80 quart ice chests.

No preservation of samples is required and the samples will be hand delivered to the laboratory.

7.0 HEALTH AND SAFETY

All personnel involved with field work for sediment sampling during the study will be required to adhere to the project health and safety plan. A project safety officer(s) will always accompany field crews entering the site. All field personnel for sediment sampling will have had current training in CPR and general first aid and will have at least 40 hours of EPA-approved advanced training in health and safety considerations at hazard waste sites.

Radio communication will be available in all field vehicles used during the investigation. As well, portable two-way radios will be used for direct communication between crews.

Any and all safety-related incidents will be reported immediately to the project safety officer who in turn will file appropriate documentation (as described in the Health and Safety Plan) with the project RSPO. Emergency contact numbers will be those identified in the project health and safety plan.

8.0 REFERENCES CITED

CH2M HILL, 1987. Silver Bow Creek Selected Data Gaps. submitted to Montana Department of Health and Environmental Sciences, January 1987.

CH2M HILL, 1987b. Quality Assurance Project Plan for the Silver Bow Creek Flood Modeling Study. Submitted to Montana Department of Health and Environmental Sciences, July, 1987.

CH2M HILL, 1987c. Laboratory Analytical Protocol for Silver Bow Creek Flood Modeling study. Submitted to Montana Department of Health and Environmental Sciences, July 1987.

MultiTech and Stiller and Associates, 1986. Silver Bow Creek Remedial Investigation Preliminary Draft Report. Submitted to Montana Department of Health and Environmental Sciences.

APPENDIX A

CH2M HILL

STANDARD OPERATING
PROCEDURES

(SOPs)

SILVER BOW CREEK
FLOOD MODELLING STUDY

CH2M HILL
STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING

1. Evaluate reach of stream to determine representative sample location site to reflect homogenous reach for channel and overbank floodplain sampling.

2. With shovel obtain approximately 1.5 cu ft sample from bedload or main channel area and place in wheelbarrow.

3. Composite and mix thoroughly.

4. Fill 80 quart ice chests 1/2 full with composite sample.

5. Repeat steps 2 thru 4 except take sample from overbank floodplain areas.

6. Decontaminate all equipment used using procedures outlined in CH2M HILL SOP-004.

7. Fill out appropriate field forms, custody forms, analysis request forms, etc. prior to leaving site.

CH2M HILL'S
STANDARD OPERATING PROCEDURE
SAMPLE DOCUMENTATION

The purpose in filling out field documents is to provide enough information to reconstruct the sampling event without relying on the memories of the field crew. It is the responsibility of the DCO to assure field documents contain sufficient detail, and are correct. All entries will be made in indelible ink, weather conditions permitting and all corrections will consist of initialed line-out deletions.

Complete and accurate sample documentation is essential for Level B criteria. The responsibility of the Document Control Officer will be to meet the Level B goal.

Documents to be completed for each sample generated during the sampling effort are:

- CH2M HILL's field log books
- Chain-of-Custody Form
- EPA Sample Tags
- Custody Seal
- SAS Packing Lists
- Sample Identification Matrix Forms

Responsibility for the completion of these forms will be with each field crew leader.

CH2M HILL'S
STANDARD OPERATING PROCEDURE
FIELD FORMS

All pertinent field survey and sampling effort information shall be recorded on a field form during each day of the field effort and at each sample site. The field crew leader shall be responsible for ensuring that sufficient detail is recorded on the field forms. No general rules can specify the extent of information that must be entered on the field form. However, field forms shall contain sufficient information so that someone can reconstruct all field activity without relying on the memory of the field crew. All entries shall be made in indelible ink, weather conditions permitting. Each day's or site's entries will be initialed and dated at the end by the author. All corrections shall consist of line-out deletions which are initialed.

At a minimum, entries on the field sheet shall include:

- Date and time of starting work and weather conditions.
- Names of field crew leader and team members
- Project name or type
- Description of site conditions and any unusual circumstances.
- Location of sample site, including map reference, if relevant
- Equipment ID numbers
- Details of actual work effort, particularly any deviations from the field operations plan or standard operating procedures

- Field observations

- Any field measurements made (e.g., pH)

For sampling efforts, specific details for each sample should be recorded. In addition to the items listed above, the following general information should be included on the field form during sampling efforts:

- Type and number of samples collected

- Sampling method, particularly deviations from standard operating procedures

Strict custody procedures shall be maintained with the field forms utilized. While being used in the field, field forms shall remain with the field team at all times. Upon completion of the field effort, field forms shall be filed in an appropriately secure manner in CH2M HILL's Helena office. Photocopies of the original field forms will be used as working documents.

CH2M HILL'S
STANDARD OPERATING PROCEDURE
EQUIPMENT DECONTAMINATION

The purpose of this section is to describe general decontamination procedures for field equipment in contact with mine/mill tailings, soil, or water. During field sampling activities, sampling equipment will become contaminated after it is used. Sampling equipment must be decontaminated between sample collection points if it is not disposable.

Field personnel must wear disposable examination gloves while decontaminating equipment at the project site. Every precaution must be taken by personnel to prevent contaminating themselves with the wash water and rinse water used in the decontamination process.

Table A-1 lists equipment and liquids necessary to decontaminate field equipment.

The following should be done in order to ensure thorough decontamination:

1. Set up the decontamination zone approximately 15 feet upwind from the sampling area. This area will be designated by the field crew leader.

2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible material.

3. The general decontamination sequence for field equipment includes: wash with Liquinox or its equivalent and DI water rinse.

4. Rinse equipment with hexane solution if sampling for organic contamination. Follow with a DI water rinse.

All disposable items (e.g., paper towels, examination gloves, wash cloths) should be deposited into a garbage bag and disposed of in an approved landfill. Contaminated wash water does not have to be collected.

If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

TABLE A-1. EQUIPMENT LIST FOR DECONTAMINATION

2-gallon plastic tubs
3-gallon pressurized garden sprayer
5-gallon plastic water-container
Liquinox (soap)
Hard bristle brushes
Garbage bags
Latex gloves
Squeeze bottles
5-gallon carboy DI water
1-pint hexane solution if applicable
Paper towels